Utah Science Education Tool

Using Three-Dimensions in a Student-Centered Classroom

By: State Science Education Coordinating Committee | Aug 2023

BACKGROUND

What are the three-dimensions and how do they help students?

The three dimensions are Science and Engineering Practices (SEPs), Crosscutting Concepts (CCCs), and Disciplinary Core Ideas (DCIs). Using these in a student-centered classroom facilitates student learning through wondering, sense-making, and problem solving to reason about a phenomenon.

SEPs are the skills that scientists and engineers use to answer questions and solve problems. They are how scientists and engineers actively engage in their work. Scientists may ask questions, design an investigation, analyze data, use models, and construct explanations as a way to make sense of phenomena they observe. The practices describe the variety of activities that are necessary to do science.

CCCs are lenses that students can use to make sense of a phenomenon. For example, looking for “patterns” in a bed of flowers vs looking at the “structure” of a plant can focus thinking and provide different evidence and reasoning around a phenomenon. In the younger grades teachers can use the CCCs to focus students on a specific aspect of a phenomenon and in upper grades students can more independently use the CCCs to reason about different aspects of a phenomenon. Understanding CCCs enables students to make connections among different subjects and to utilize science in diverse settings.

DCIs include the most fundamental and explanatory pieces of knowledge in a discipline. They are often what we traditionally associate with science knowledge and specific subject areas within science. These core ideas are organized within physical, life, and earth sciences. The DCIs are identified in The Framework for K-12 Science Education and organized to engage students at an age-appropriate depth of knowledge that will allow them develop their understanding over a lifetime.

Why are the three-dimensions important to three-dimensional science instruction?

Teachers who utilize the three dimensions in a student-centered classroom move from teacher-led instruction to facilitating discussions and providing learning experiences where students use their prior knowledge, obtain new information, and collaborate with their peers to extend their understanding.

CLASSROOM APPLICATION

When observing a classroom in which the instruction uses the three-dimensions, the following **student actions** should be visible:

- Students use SEPs to make sense of phenomena.
- Students use the CCCs to frame their thinking.
- Students use DCIs to explain phenomena and solve problems.

To support instruction that is three-dimensional, **teachers**' plan by:

1. Identifying phenomena that help students build an understanding of DCIs.
2. Writing a sample student explanation of the phenomenon that uses the DCIs.
3. Selecting appropriate SEPs, CCCs and scaffolds to plan learning tasks that facilitate student learning and discourse around the DCIs.

IMPLEMENTATION RUBRIC

Basic	Emerging	Effective	Exceptional
Students do not use the SEPs and CCCs to use and reason about DCIs to make sense of a phenomenon.	**Students** use either the SEPs or CCCs to use and reason about DCIs to make sense of a phenomenon.	**Students** use both the SEPs and CCCs as prompted from the teacher to use and reason about DCIs to make sense of a phenomenon.	**Students** authentically use both the SEPs and CCCs to use and reason about DCIs to make sense of a phenomenon.
Teacher instruction focuses on direct instruction and confirmation lab experiences not connected to the student exploration of a phenomena.	**Teacher** instruction focuses on direct instruction and confirmation lab experiences, which may be directly connected to a phenomena.	**Teacher** instruction focuses on student-centered learning to explore phenomena by prompting students to use SEPs and CCCs to reason about DCIs.	**Teacher** instruction supports students-centered learning to explore phenomena authentically by using SEPs and CCCs to reason about DCIs.

RESOURCES

- A Framework for K-12 Science Education: Chapters 1, 3, and 4.
- Introduction to the SEEd Standards: Pages 11-14.
- NGSS@NSTA: Resources for SEP, CCC, and DCI pages.